

A photograph showing a coastal cityscape with a prominent sand dune in the foreground. The dune is light-colored and appears to be eroding or has been excavated. In the background, several high-rise buildings are visible under an overcast sky. A yellow structure, possibly a lifeguard stand, is situated on the dune. The overall scene suggests a coastal area affected by sea level rise or erosion.

Sea Level Rise Science update

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Gold Coast Main Beach (Brisbane Times 2015)

Acknowledgement of Country



Acknowledgement of the traditional custodians of the country on which we meet and their connection to land, sea and community.

We pay our respects to their Elders past, present and emerging.

Introduction

Climate Change Science (IPCC AR6 / SROCC):

- Observed and projected climate changes - sea level rise.
- Low likelihood, high impact SLR scenario.

Australian and SA local impacts (BOM / CSIRO):

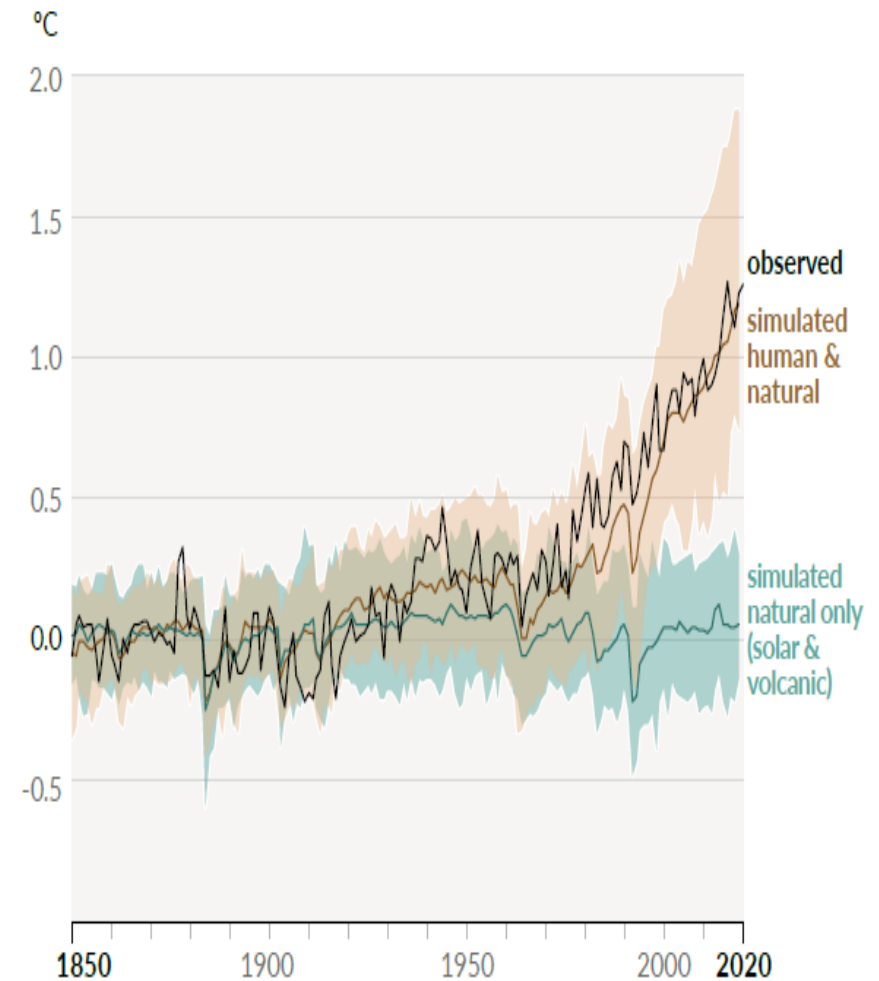
- Observed and projected changes
- Australian coastal zone impacts

Taking action – Adaptation options



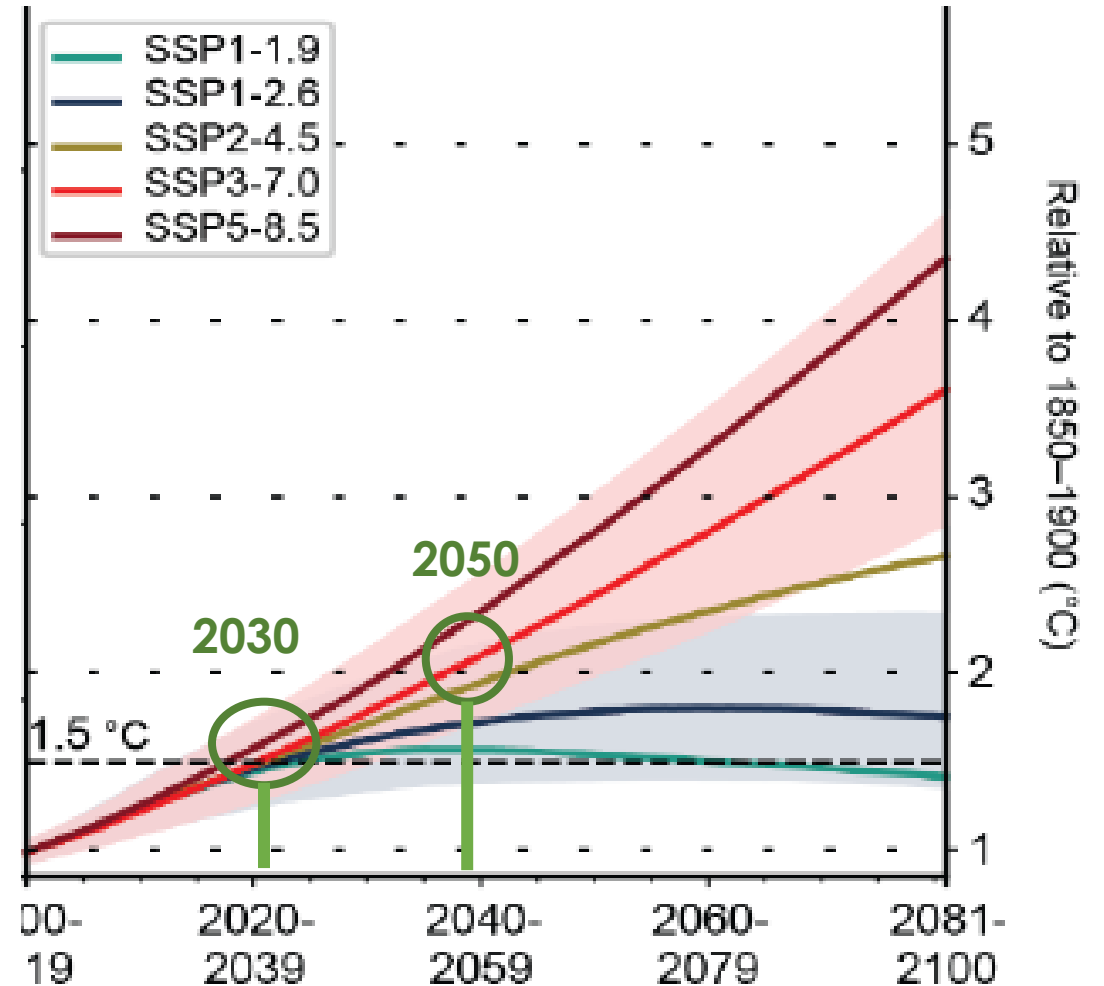
Climate change science - Observed

- Current CO₂ levels 419ppm (Daily CO₂), CO₂e levels 516ppm (BOM 2022) – 61% increase CO₂ since 1990 (CSIRO 2022).
- GHG levels higher than at any time in at least 2 million years (BOM 2022).
- Global surface warming 1.09°C since 1850-1900 (1.6°C over land) (AR6).
- Ocean surface acidification now the highest in 2 million years (AR6).
- Sea levels risen by 250mm since 1880 and increased in rate from 1.3mm/ year before 1970 to 3.7mm/year since 2006 (AR6).



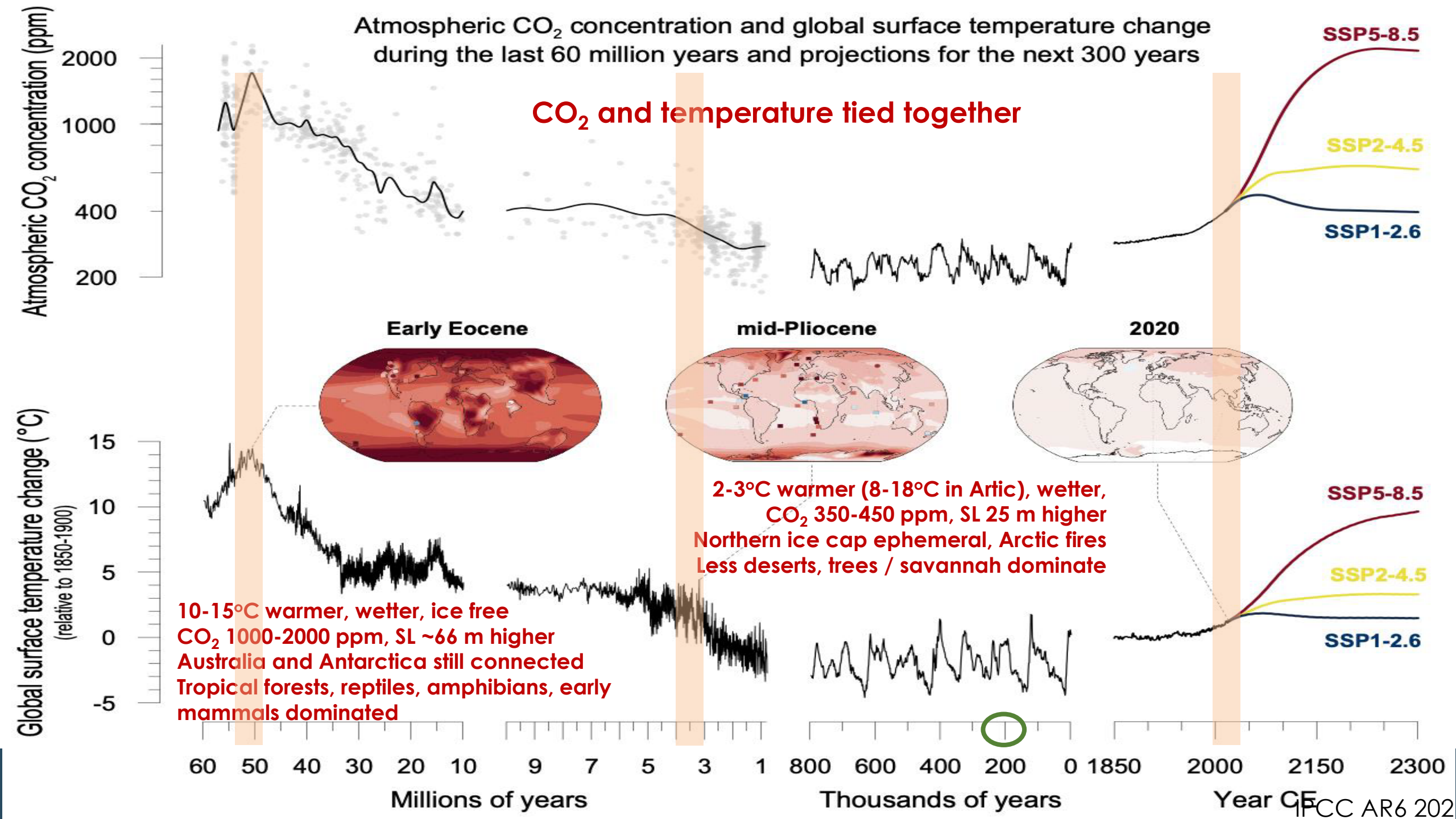
Future projections (AR6)

- Current SSP3-7.0 approx. 3 – 4.5°C by 2100 (red line).
- Global warming projected to be 1.5°C by early 2030s.
- To have a chance of staying below 2°C, emissions must fall to about 45% of 2010 levels by 2030 and **net zero** by 2050 + interventions.
- If current commitments kept warming is expected to reach 2.4°C
- Greenhouse gas emissions continue to rise....



Atmospheric CO₂ concentration and global surface temperature change during the last 60 million years and projections for the next 300 years

CO₂ and temperature tied together

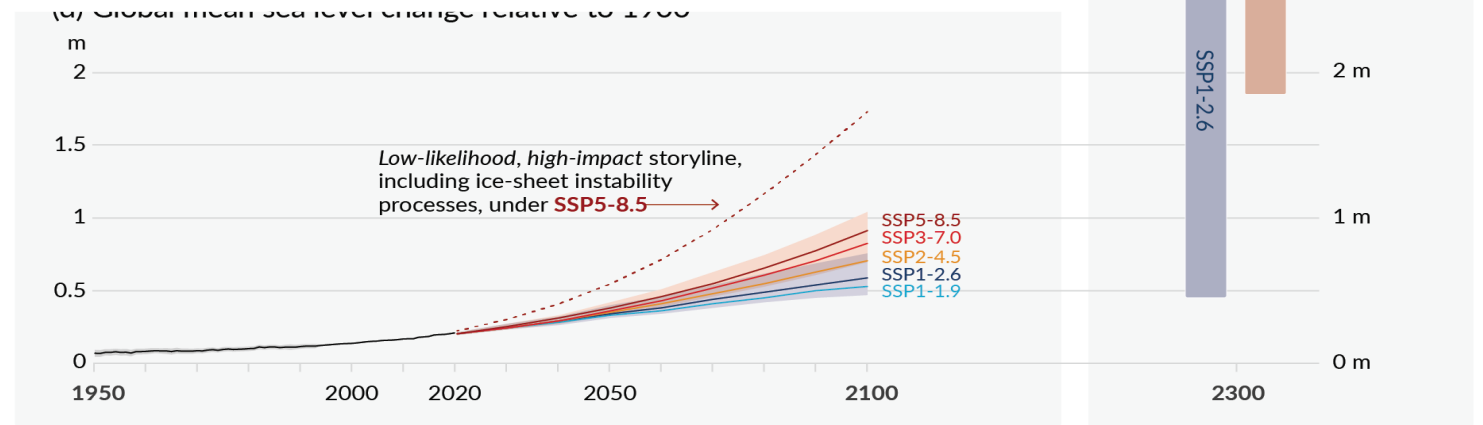


Climate change science (AR6) - Future

- Warming of 1.5°C and 2.0°C will be exceeded before 2100 without immediate, deep cuts to emissions and interventions.
- The mid-range SSP2-4.5 increase temp 2.1-3.5°C last seen 3 million years ago. However, current emissions follow the SSP 3–7.0 scenario.
- Further increases in temperatures, extreme rainfall, ice melt, sea level rise, ocean acidification / de-oxygenation.
- Increases in extreme events incl. heatwave , bushfire, flooding.
- Extreme heat events that occurred 1 in 10 years will happen 4.1x at 1.5°C and 5.6x at 2°C.
- 1:100 year sea level events will occur 2-3x *annually* by 2100.

Global Sea Level Rise to 2300

- Sea level and impact depends on timeframe... “Over the next 2000 years, global mean sea level will rise by about 2 to 3 m if warming is limited to 1.5°C, 2 m to 6 m if limited to 2°C and 19 m to 22 m with 5°C of warming, and it will continue to rise over subsequent millennia”. (Approx. 60 m for an ice free planet).
- “For urban planning and infrastructure purposes, total global sea level rise exceeding 2 m by 2100 should be considered”.



The low likelihood, high impact scenario

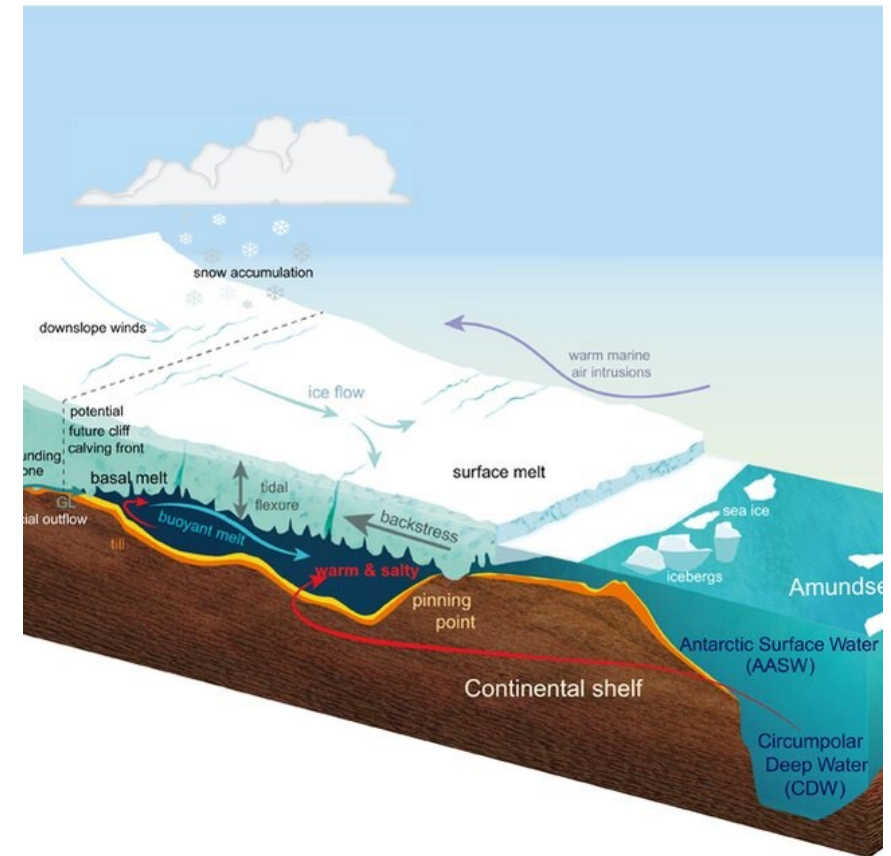
- “Global mean sea level rise above the *likely* range – approaching 2 m by 2100 and 5 m by 2150 under a very high GHG emissions scenario (SSP5-8.5) cannot be ruled out due to deep uncertainty in ice-sheet processes” (IPCC AR6).
- “Global mean sea level might rise well above the *likely* range before 2100, which is reflected by assessments of ice-sheet contributions based on structured expert judgement leading to a 95th percentile of projected future sea level rise as high as 2.3 m in 2100” (SROCC, 2019).



Scientists confirm dramatic melting of the Greenland Ice sheet (The Guardian 2021).

The low likelihood, high impact scenario

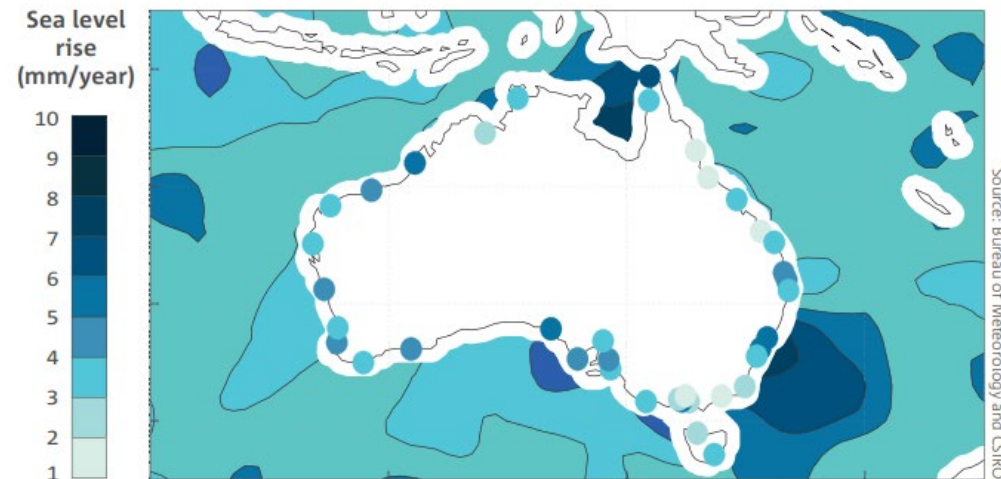
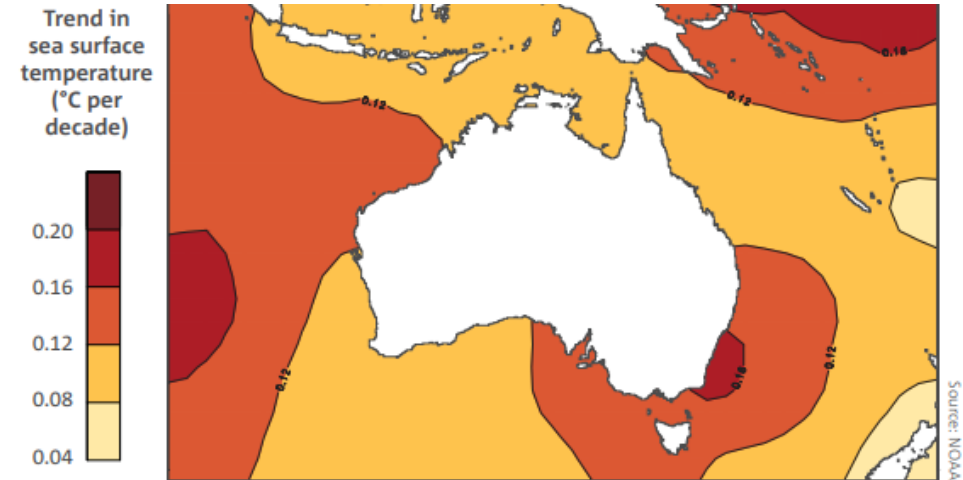
- The higher resolution CMIP 6 models and recent observations are indicating that ice sheet sensitivity to warming is greater than previously modelled.
- Paleoclimate studies imply that CO_2 was about 300 ppm in the Pliocene and 400 ppm at transition to a nearly ice-free planet and so there is a lot of sea level rise “in the pipeline”.
- The Antarctic Thwaites Glacier and ice sheet alone have the capacity to raise global sea levels by up to 3 m.



Schematic of the Thwaites Glacier and icesheet, Antarctica showing undersea cavity (NASA 2023).

Australian ocean changes – observed

- Australia has warmed by 1.47°C since 1910, sea surface temperatures have increased by an average of 1.05 °C since 1900.
- Increase in the frequency of extreme marine heat events.
- Sea levels are rising at all high quality tidal gauges and satellite altimetry points (3-5mm/yr SA).
- More frequent high water extremes.



Australian coasts - project sea level rise

- Australian SLR expected to follow global rates but higher in the north and SE of continent due to higher temperatures.
- Beach loss forecasts using satellite images of mapped shoreline change (1984 and 2015) show 0.7 m SLR = 12,000 km but 1.0 m = 15,000 km.
- Mid range sea-level rise of 0.5 metres in the 21st century, events that now happen every 10 years would happen about every 10 days.
- Some areas of the coast are already uninhabitable, loss and damage as a result of actions of the sea are not usually insurable.
- Inundation maps are available from Coastal Risks Australia at <https://www.coastalrisk.com.au/viewer>



Port Adelaide Enfield with 0.84 m SRL (Coastal Risks Australia).

Impacts to coastal Councils

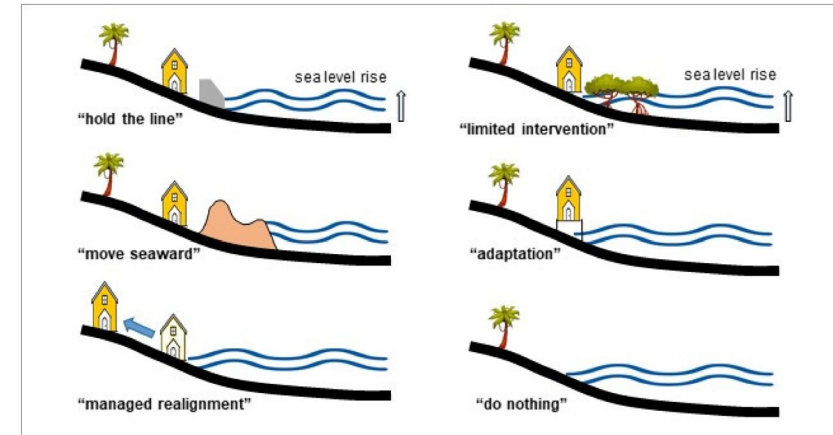
- All coastal assets less than 2-3 m above current 1:100 AEP - and those further from the coast that are subject to saline groundwater intrusion are at risk within planning timeframes.
- Physical and chemical wear / damage to exposed assets and reduction in useful life.
- Interruptions to service.
- Climate stress on green infrastructure (vegetation, trees, living shorelines).
- Management impacts (planning, adaptation).



Several beachfront homes at Wamberal (NSW) are in danger of collapsing (NT news 2020).

Coastal adaptation strategies

- Adaptation actions include: Accommodate; Protect / Defend; or Retreat.
- No regrets, Low-regrets, Win-win and flexible measures are all required.
- Preference green infrastructure (living shorelines, vegetated dunes, mangroves, artificial reefs).
- Limit grey infrastructure (sea walls, groins, training walls).



Rehabilitated coastal dunes – Holdfast Bay
(Living Shorelines Australia (2023)).

Climate change and Australians

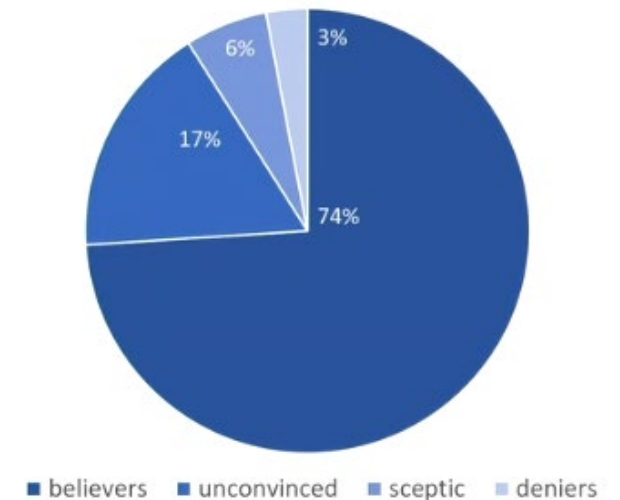
Griffith University National Survey on climate change (2022) had similar results to last year:

- 9% climate change deniers or sceptics (older/less educated/conservative/males/religious/rural);
- 74% firm believers (younger/women/better educated/urban/lived experience);
- 71% *fairly* or *very* concerned about climate change.

We are willing to:

- 61% Have renewable energy infrastructure near our home (e.g. solar farm);
- 70% Greatly reduce energy use;
- 50% work to adapt to changes.

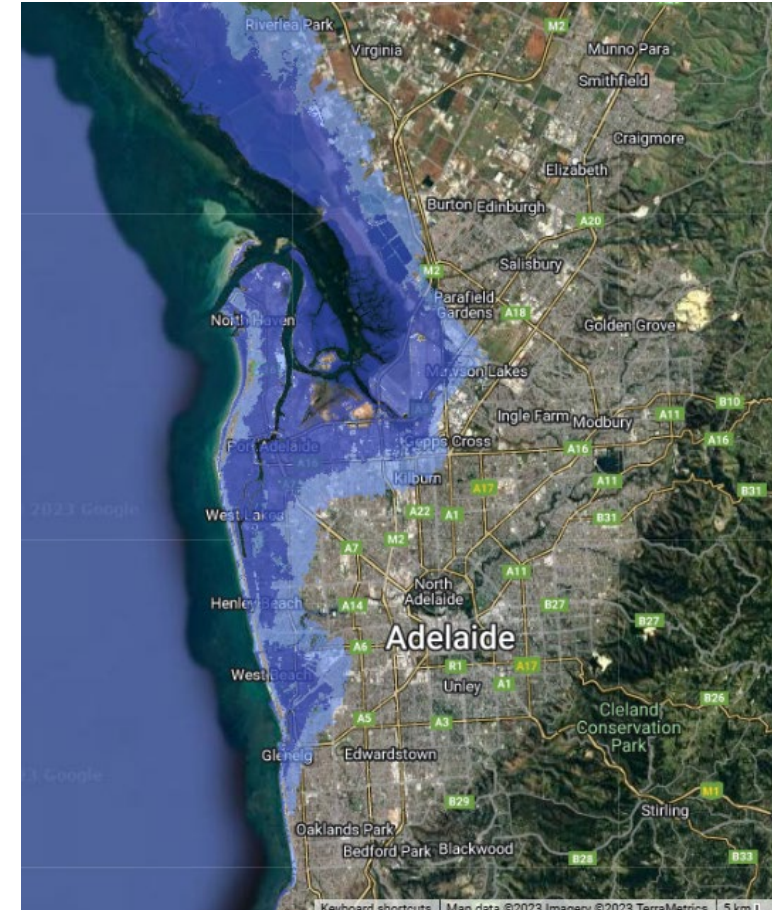
Do Australians believe climate change is real?



Griffith University 2023

Conclusion

- Sea level rise is occurring globally and around Australia at a current rate of 3-5 mm per year.
- Sea level rise will continue for thousands of years as heat is transferred.
- The low-likelihood sea level rise scenario comes with catastrophic consequences – could be considered high risk.
- For urban development and infrastructure decisions, sea level rise *exceeding* 2 m is recommended.... See image of Adelaide from Coastal Risk Australia for inundation from the highest astronomical tide + 2m SLR.



Adelaide with a global sea level rise of 2m on HAT as recommended by IPCC (Coastal Risk Australia).

An aerial photograph of New York City, showing a dense grid of skyscrapers and buildings. The city is surrounded by water, with bridges visible in the distance. The text "THANK YOU" is overlaid in large white letters across the center of the image.

THANK YOU

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Image: John Blackford 2016